INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

M00/420/S(3)

CHEMISTRY
STANDARD LEVEL
PAPER 3

Wednesday 17 May 2000 (morning)

1 hour 15 minutes

Name

Number

INSTRUCTIONS TO CANDIDATES

- Write your candidate name and number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from three of the Options in the spaces provided. You may continue your answers in a continuation answer booklet, and indicate the number of booklets used in the box below. Write your name and candidate number on the front cover of the continuation answer booklets, and attach them to this question paper using the tag provided.
- At the end of the examination, indicate the letters of the Options answered in the boxes below.

OPTIONS ANSWERED		EXAMINER	TEAM LEADER	IBCA
		/15	/15	/15
		/15	/15	/15
		/15	/15	/15
NUMBER OF CONTINUATION BOOKLETS USED	. . . . .	TOTAL /45	TOTAL /45	TOTAL /45

Option A – Higher Organic Chemistry

A1. Two isomers **A** and **B** of empirical formula C_5H_{12} give mass spectra showing peaks corresponding to molecular ions and other major fragments with mass-to-charge values as follows:

A	72	57	42	27	12
B	72	57	43	29	15

(a) (i) Give the molecular formula of **A** and **B**. *[1]*

. . . . . .

(ii) Give the structural formulas of the **three** isomers of this hydrocarbon. *[3]*

(iii) With respect to the mass spectrum of **A**, identify, with a brief explanation, **one** fragment which would cause the observed mass losses. *[2]*

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(iv) With respect to the mass spectrum of **B**, identify **one different** fragment which would cause the observed mass losses. *[1]*

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(v) Give the structures of **A** and **B** and name each of them. *[4]*

(This question continues on the following page)

(Question A1 continued)

(b) Briefly describe and explain the ^{1}H NMR spectrum of isomer **A**. Indicate the number of different chemical environments of the hydrogen atoms in isomer **B**. *[3]*

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(c) State why infrared spectroscopy is less useful than mass spectroscopy and ^{1}H NMR spectroscopy in distinguishing between **A** and **B**. *[1]*

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Option B – Higher Physical Chemistry

B1. This question relates to aqueous solutions of hydrochloric acid and ethanoic acid, each having a concentration of 0.1 mol dm^{-3}.

(a) Calculate the pH values of each solution. *[3]*

(i) HCl

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(ii) CH_3COOH ($K_a = 1.7 \times 10^{-5}\ \text{mol dm}^{-3}$)

(b) Compare the volumes of 0.1 mol dm^{-3} aqueous sodium hydroxide required to react completely with 20 cm^3 of each solution. Explain your answer. *[2]*

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(c) State what is meant by a buffer solution. *[1]*

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(This question continues on the following page)

(Question B1 continued)

(d) Which of the solutions produced by the partial neutralisation of HCl or CH_3COOH could be used as a buffer? Explain your answer. *[2]*

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(e) Why can the acid solutions themselves **not** be used as buffers? *[2]*

(i) HCl

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(ii) CH_3COOH

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B2. The following equation represents the reaction between hydrogen and nitrogen(II) oxide. The reaction is first order with respect to hydrogen and second order with respect to nitrogen(II) oxide.

$$2H_2(g) + 2NO(g) \rightarrow 2H_2O(g) + N_2(g)$$

(a) Write down the rate equation and give the overall order of this reaction. *[4]*

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(b) What would be the effect on the reaction rate of doubling the concentration of **both** reactants? *[1]*

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Option C – Human Biochemistry

C1. (a) (i) Draw the straight-chain formula of glucose and circle a carbon atom in the structure which is **not** chiral. *[2]*

(ii) Describe the structural difference between α-glucose and β-glucose. *[2]*

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(b) Give the names of the monosaccharides which condense to form

(i) sucrose; *[2]*

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(ii) starch. *[1]*

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(c) State **one** major function of a polysaccharide in the body. *[1]*

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C2. (a) How many different tripeptides can be formed using three α-amino acids, glycine, alanine and valine, if each amino acid is used only once in each tripeptide? *[1]*

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(b) (i) Name **two** methods by which an unknown tripeptide can be analysed. *[2]*

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(ii) For **one** of these methods outline the experimental procedure and give the information which would be needed to identify the individual amino acids. *[4]*

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Option D – Environmental Chemistry

D1. (a) For **each** of the air pollutants listed below, state its source and **one** process by which its emission into the atmosphere could be reduced. State the product(s) formed from the pollutant in **one** of the processes. *[6]*

(i) Carbon monoxide:

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(ii) Sulphur dioxide:

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(iii) Nitrogen oxides:

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(b) Identify **one** gas, from the above list, which contributes to acid rain and write an equation for its reaction with water. *[2]*

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D2. (a) Explain what is meant by *Biological Oxygen Demand* (BOD), and describe the effect of a high BOD in water. *[2]*

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(b) Identify the stage of sewage treatment which removes the substances responsible for BOD and explain how this is done. *[3]*

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(c) Discuss how the addition of nitrates **or** phosphates to water can contribute to the BOD. *[2]*

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Option E – Chemical Industries

E1. (a) Complete the table below to show the conditions used in the Haber and Contact processes, for the manufacture of ammonia and sulphur trioxide, respectively. *[4]*

	HABER	CONTACT
Temperature / ° C		
Pressure / atm		
Identity of catalyst		

(b) Write a balanced equation for the manufacture of ammonia (ΔH is negative). Explain the choice of the temperature used. *[4]*

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(c) The hydrogen used in the manufacture of ammonia can be obtained by the process of *reforming*. Give the raw material(s), the conditions and a possible equation for the process. *[3]*

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E2. (a) List **two** important factors which should be considered when choosing a location for the manufacture of polythene. *[2]*

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(b) Explain why polyvinyl chloride is less flexible than polythene. *[2]*

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Option F – Fuels and Energy

F1. (a) Radium-223, ^{223}Ra, emits α-particles when it decays.

(i) Write the mass number and atomic number of the heavier product formed by this decay. *[2]*

Mass number: . . . . . .

Atomic number: . . . . . .

(ii) What happens to the mass number and the atomic number of an element if it undergoes β-decay? *[2]*

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(b) The intensity of radiation emitted by a certain mass of ^{223}Ra falls to $\frac{1}{8}$ of its original value after 35.1 days.

(i) Define *half-life*. *[1]*

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(ii) Calculate, showing your working, the half-life of ^{223}Ra. *[2]*

(iii) Calculate the fraction of ^{223}Ra which has decayed after 35.1 days. *[1]*

(iv) Calculate the fraction of ^{223}Ra **remaining** at this time if the original mass had been twice as great. *[1]*

F2. (a) Identify the two electrodes in the Leclanché dry cell. *[2]*

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(b) Describe the difference between *voltage* and *power* for such a cell **and** identify the factors that affect the voltage and the power. *[4]*

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